WHAT IS CLAIMED IS:

1. A method for controlling blood flow through an extracorporeal blood circuit comprising the steps of:

a. withdrawing the blood from a withdrawal blood vessel in a patient into the extracorporeal circuit;

b. detecting an occlusion which at least partially blocks the withdrawal of blood from the patient, and

c. temporarily reversing a flow of the blood to infuse blood from the circuit into the withdrawal blood vessel after step b.

2. A method for controlling blood flow as in claim 1 wherein the occlusion is detected based on a pressure measurement of the blood in the circuit.

3. A method for controlling blood flow as in claim 1 wherein step (a) is repeated after step (c).

4. A method for controlling blood flow as in claim 1 wherein blood flow is reversed after the blood flow is substantially reduced during step (a).

5. A method for controlling blood flow as in claim 1 wherein blood flow is reversed after the blood flow is substantially reduced to zero flow during step (a).

6. A method for controlling blood flow as in claim 1 wherein blood flow is reversed after the withdrawal blood vessel collapses.

7. A method for controlling blood flow as in claim 1 wherein the flow is temporarily reversed after an occlusion has been detected in the withdrawal blood vessel.

8. A method for controlling blood flow as in claim 1 wherein the blood flow is reversed for a predetermined duration.

9. A method for controlling blood flow as in claim 1 wherein the reversed blood flow has a predetermined flow rate.

10. A method for controlling blood flow as in claim 9 wherein the flow rate is substantially less than the flow rate during step (a) and prior to step (b).

11. A method for controlling blood flow as in claim 1 wherein the step (a) is repeated after step (c) when a flow capacity of the withdrawal blood vessel substantially increases.

12. A method for controlling blood flow as in claim 1 further comprising a step of gradually reducing blood flow prior to step (b).

13. A method of controlling an extracorporeal blood circuit comprising the steps of:

a. withdrawing blood from a withdrawal blood vessel in a patient into the extracorporeal circuit;

b. determining a withdrawal blood pressure in the extracorporeal circuit;

c. withdrawing blood at a flow rate selected to reduce a difference between the withdrawal pressure and an occlusion limit which is a function of blood flow through the circuit and withdrawal pressure, and

d. temporarily reversing blood flow to infuse blood from the circuit into the withdrawal blood vessel if the flow rate selected in step (b) is reduced to below a predetermined limit;

14. A method of controlling an extracorporeal blood circuit as in claim 13 wherein the predetermined limit is a blood flow rate of substantially zero.

15. A method of controlling an extracorporeal blood circuit as in claim 13 further comprising the steps of:

e. detecting an occlusion which at least partially blocks the withdrawal of blood from the patient, and

f. temporarily reversing a flow of the blood to infuse blood from the circuit into the withdrawal blood vessel if the step (b) of the algorithm is unsuccessful in maintaining significant blood flow.

16. A method for controlling withdrawal of blood from a patient into an extracorporeal circuit, and allowing for detection of and recovery from a reduced flow capacity or total occlusion of a withdrawal blood vessel, comprising the steps of:

a. reducing blood flow being withdrawn from the patient when a withdrawal pressure of the blood in the circuit becomes more negative than an occlusion limit that is a function of blood flow through the circuit, and

b. if the reduced blood flow is reduced below a predetermined minimal flow during step (a), then temporarily reversing the flow of blood in the circuit and infusing blood into the withdrawal blood vessel.

17. A method as in claim 16 further comprising the steps of:

c. prior to step (a), increasing a rate of blood being withdrawn until the withdrawal blood vessel begins to collapse and occlude blood withdrawal;

d. prior to step (a), determining an occlusion withdrawal pressure corresponding to collapse of the vessel,

e. initiating step (b) when the collapse withdrawal pressure is detected.

18. A method as in the claim 17 wherein the collapse withdrawal pressure is a variable and a function of withdrawal blood flow.

19. A method as in claim 17 wherein the collapse withdrawal pressure is periodically reestablished by stopping the blood flow through the circuit pump and then performing steps (c), (d) and (e).

20. A system for controlling blood flow withdrawn from a patient comprising:

an extracorporeal circuit having a blood passage including a blood withdrawal tube, a treatment device and an infusion tube,

a pressure sensor coupled to said withdrawal tube and sensing a blood pressure in the withdrawal tube;

a pump coupled to the circuit and adapted to move blood through the blood passage at a controlled flow rate, and

a pump controller receiving a blood pressure signal from the pressure sensor and controlling the pump to regulate the controlled flow rate, wherein the pump controller includes a processor and a memory storing a control algorithm of a variable withdrawal pressure target as a function of flow rate, said controller reduces the controlled flow rate based on a difference between a withdrawal pressure sensed by the pressure sensor and the withdrawal pressure target, and said controller reverses blood flow to infuse blood into the patient through the withdrawal tube if the controlled flow rate is reduced below a predetermined limit.

21. A system as in claim 20 wherein the pump controller includes a proportional integral feed forward pressure controller.

22. A system as in claim 20 wherein the treatment device is a hemofilter.

23. A system as in claim 20 wherein the treatment device is a dialysis device.

24. A system as in claim 20 wherein the pressure sensor is a real time sensor providing real time pressure signals to the pump controller.

25. A system as in claim 20 wherein the pump includes a direct DC drive motor.

26. A system as in claim 25 wherein the drive motor is a brushless motor.

27. A system as in claim 20 wherein the treatment device is a blood filter.

28. A system as in claim 20 wherein the pressure controller alternatively controls a withdrawal pressure and an infusion pressure by synchronized switching.

29. A method for controlling blood flow in a closed loop extracorporeal blood circulation system where blood is withdrawn and returned into a blood vessel in the same body in the process of treatment comprising the steps of:

a. withdrawing blood from a blood vessel of the patient at a controlled flow rate;

b. measuring a withdrawal pressure of the withdrawn blood;

c. infusing the withdrawn blood into the patient;

e. measuring the infusion pressure of the blood;

f. comparing the withdrawal pressure to a withdrawal pressure target, and comparing the infusion pressure to an infusion pressure target;

g. adjusting the flow rate to reduce a difference between the withdrawal pressure and a withdrawal pressure target, if the infusion pressure is less than an infusion pressure target, and

h. adjusting the flow rate to reduce a difference between the infusion pressure and an infusion pressure target, if the infusion pressure is greater than the infusion pressure target.

30. A method as in claim 29 wherein step (h) includes applying a difference between the infusion pressure and the infusion pressure target as feedback to adjust the flow rate of the blood being withdrawn.

31. A method as in claim 29 wherein the blood is withdrawn through a withdrawal needle and infused through an infusion needle.

32. A method as in claim 31 wherein the blood is withdrawn through a needle and infused through said needle.

33. A method as in 29 wherein blood is withdrawn from and infused into a peripheral vein of a patient.

34. A method for limiting pump pressure in an extracorporeal blood circuit coupled to a pump driven by a direct DC drive motor, wherein the method comprises the steps of:

a. measuring current used by the motor,

b. limiting pressure in said blood circuit by controlling said current, and

c. controlling the current based on a difference between a measured blood pressure in the circuit and a pressure target.

35. A method for controlling blood infusion into a mammalian patient in an air-free extracorporeal blood circuit comprising the steps of:

a. infusing blood from the circuit into a blood vessel of the patient at a controlled infusion flow rate;

b. measuring an infusion pressure of the blood being infused;

c. comparing the measured infusion pressure to a disconnect pressure target;

d. sensing for air in the blood being infused;

e. generating a disconnection alarm if both the measured infusion pressure is no greater than the disconnect pressure target and air is sensed in the blood being infused.

36. A method for controlling blood infusion as in claim 35, further comprising the step of reducing a rate of infusing blood if the measured infusion pressure is greater than the disconnect pressure target and air is not sensed in the blood being infused.